

Claims

- [c1] An apparatus for removing at least one molded part from a trim press associated with a thermoforming process wherein the trim press is moveable between an open and closed position and is adapted to separate the at least one molded part from a web of material used in the thermoforming process, said apparatus comprising:
- a cutting tool associated with the trim press, said cutting tool completely severing the at least one molded part from the web of material when the trim press is in its closed position;
 - a support structure positioned adjacent the trim press;
 - a pick and place mechanism mounted on said support structure;
 - a drive system for moving and manipulating the pick and place mechanism within the trim press when the trim press is in its open position;
 - holding means associated with the trim press for holding the at least one severed molded part within the trim press after severing occurs;
 - holding means associated with the pick and place mechanism for capturing and holding the at least one molded part when the trim press is in its open position and when

the pick and place mechanism is maneuvered adjacent the at least one severed molded part; and controller means for controlling movement of the pick and place mechanism into and out of the trim press, movement of the pick and place mechanism being synchronized with the opening and closing of the trim press such that the pick and place mechanism will engage and remove the at least one molded part from the trim press when the trim press is in its open position.

[c2] The apparatus defined in Claim 1 wherein said pick and place mechanism includes a plurality of members each having at least one holding means for engaging and holding the at least one molded part.

[c3] The apparatus defined in Claim 2 wherein said at least one holding means includes suction means.

[c4] The apparatus defined in Claim 1 wherein said pick and place mechanism includes a plurality of members each having a plurality of holding means associated respectively therewith for engaging and holding a plurality of severed molded parts.

[c5] The apparatus defined in Claim 4 wherein said holding means include suction means.

[c6] The apparatus defined in Claim 4 wherein said plurality

of holding means are segregated into multiple zones, each zone being independently operable.

- [c7] The apparatus defined in Claim 1 wherein the holding means associated with the trim press includes suction means.
- [c8] The apparatus defined in Claim 1 wherein the holding means associated with the trim press includes a plurality of orifices, said plurality of orifices being adapted for pulling a vacuum therethrough so as to maintain the at least one severed molded part in its respective position within the trim press from the time such at least one molded part is severed from the web of material through the opening of the trim press and capture of such at least one molded part by the holding means associated with the pick and place mechanism.
- [c9] The apparatus defined in Claim 1 wherein said support structure is fixedly mounted to the trim press.
- [c10] The apparatus defined in Claim 1 wherein the trim press includes an upper platen and a lower platen, said support structure being fixedly mounted to the trim press so as to maintain a constant relationship with at least the lower platen when the upper and lower platens are adjusted.

[c11] The apparatus defined in Claim 1 wherein said support structure includes a pair of horizontal support members each having a drive system associated respectively therewith, at least one vertical support member having a drive system associated respectively therewith, and a substantially U-shaped carriage member coupled to the horizontal and vertical support members and their respective drive systems for horizontal and vertical movement.

[c12] The apparatus defined in Claim 11 wherein said pick and place mechanism is coupled to said carriage member.

[c13] The apparatus defined in Claim 11 wherein said carriage member includes a quick disconnect mechanism, said quick disconnect mechanism being adapted to engage and hold the pick and place mechanism.

[c14] The apparatus defined in Claim 11 including a drive system coupled to said support structure for rotationally moving said pick and place mechanism relative to at least some of said support members.

[c15] The apparatus defined in Claim 1 wherein said pick and place mechanism is maneuverable beneath the path of the web of material that continues through the trim press during the thermoforming process.

- [c16] The apparatus in Claim 13 wherein said quick disconnect mechanism includes means for providing a vacuum to the pick and place mechanism.
- [c17] The apparatus defined in Claim 1 wherein said controller means are programmable.
- [c18] The apparatus defined in Claim 1 including a conveyance system positioned adjacent the trim press for receiving the at least one severed molded part from the pick and place mechanism.
- [c19] The apparatus defined in Claim 18 wherein at least a portion of said conveyance system is positioned and located beneath said support structure.
- [c20] The apparatus defined in Claim 1 wherein said holding means associated with the pick and place mechanism includes multiple holding zones.
- [c21] An apparatus for removing a plurality of thermoformed parts from a trim press associated with a thermoforming process wherein the trim press is moveable between an open and closed position and is adapted to separate the thermoformed parts from a sheet of material which is fed through the thermoforming process and through the trim press, said apparatus comprising:

a cutting tool associated with the trim press for completely severing the plurality of thermoformed parts formed within the sheet of material from the sheet of material when the trim press is in its closed position; a support structure mounted adjacent the trim press; a pick and place mechanism mounted to said support structure for movement into and out of the trim press; a plurality of orifices associated with the trim press for pulling a vacuum therethrough, said orifices being positioned and located so as to hold the severed thermoformed parts once the parts are severed from the sheet of material;

vacuum means associated with the pick and place mechanism for engaging and holding the severed parts until removal from the trim press; and

programmable controller means for controlling movement of the pick and place mechanism into and out of the trim press, movement of the pick and place mechanism being synchronized with the opening and closing of the trim press such that the plurality of severed thermoformed parts can be removed therefrom.

[c22] The apparatus defined in Claim 21 wherein said support structure includes a pair of horizontal support members and a pair of vertical support members, at least one of said horizontal support members and at least one of said

vertical support members having a drive system associated respectively therewith, a carriage member coupled to at least some of said horizontal and vertical support members and to the respective drive systems for movement in both the horizontal and vertical direction, and a quick disconnect mechanism associated with said carriage member for engaging and holding said pick and place mechanism.

[c23] The apparatus defined in Claim 21 wherein said pick and place mechanism includes a plurality of members each having a plurality of suction means associated therewith for engaging the severed parts, said suction means being positioned and located so as to coincide with the position and location of the severed parts within the trim press.

[c24] The apparatus defined in Claim 23 wherein said plurality of suction means are segregated into multiple zones, each zone being independently operable.

[c25] The apparatus defined in Claim 21 wherein said pick and place mechanism is positioned and located relative to said support structure so as to move beneath the path of the sheet of material that continues through the trim press during the thermoforming process.

[c26] The apparatus defined in Claim 21 wherein the pick and place mechanism is positioned and located relative to said support structure so as to move above the path of the sheet of material that continues through the trim press during the thermoforming process.

[c27] The apparatus defined in Claim 21 including a conveyance system positioned and located adjacent said support structure for receiving the severed parts from the pick and place mechanism when they are removed from the trim press.

[c28] The apparatus defined in Claim 27 wherein the conveyance system is positioned and located such that at least a portion thereof passes beneath said support structure.

[c29] In a thermoforming system for forming a plurality of thermoformed articles from a sheet of thermoplastic material wherein said system includes a heater station for heating the sheet of material to its glass transition phase, a forming station where the sheet of material is formed into the specific shape of the articles being manufactured, and a trim press for removing the thermoformed articles from the sheet of material, the trim press being moveable between an open and closed position, the improvement comprising:

a plurality of knife blades associated with the trim press for completely severing the plurality of thermoformed articles from the sheet of material when the trim press is in its closed position;

a support structure positioned adjacent the trim press, said support structure including at least a pair of horizontal support members and at least a pair of vertical support members, a carriage member coupled to said horizontal and vertical support members, and a quick disconnect mechanism associated with said carriage member;

a pick and place mechanism mounted to said quick disconnect mechanism for movement into and out of the trim press;

a drive mechanism associated with some of said support members for moving said pick and place mechanism in at least a horizontal and vertical direction relative to said horizontal and vertical support members;

vacuum means associated with the trim press for holding the severed thermoformed articles within the trim press until removed therefrom;

vacuum means associated with said pick and place mechanism for capturing and holding the plurality of severed thermoformed articles when said pick and place mechanism is maneuvered into the trim press; and
controller means for controlling movement of the pick

and place mechanism into and out of the trim press, movement of the pick and place mechanism being synchronized with the opening and closing of the trim press.

- [c30] The improvement defined in Claim 29 wherein said pick and place mechanism includes a plurality of members each having a plurality of vacuum means association therewith for engaging the plurality of severed thermoformed articles within the trim press.
- [c31] The improvement defined in Claim 29 wherein the pick and place mechanism moves beneath the path of the sheet of material that moves through the thermoforming system and through the trim press.
- [c32] The improvement defined in Claim 29 including a conveyance system positioned adjacent to the trim press and adjacent the support structure for receiving the plurality of severed thermoformed articles from the pick and place mechanism.
- [c33] The improvement defined in Claim 32 wherein at least a portion of said conveyance system passes underneath said support structure.
- [c34] The improvement defined in Claim 32 wherein said controller means controls the movement of the pick and

place mechanism from the trim press to the conveyance system.

[c35] The improvement defined in Claim 34 wherein said controller means controls the stacking of severed thermoformed articles onto the conveyance system.

[c36] A method for removing at least one molded part from a trim press associated with a thermoforming process wherein the trim press is moveable between an open and closed position and is adapted to separate the at least one molded part from a web of material used in the thermoforming process, said method comprising the following steps:

maneuvering the web of material and the at least one molded part formed therein into the trim press;

completely severing the at least one molded part from the web of material within the trim press;

holding the at least one severed molded part within the trim press after the part is completely severed from the web of material and the trim press is moved to its open position;

positioning a pick and place tool within the trim press for locating and acquiring the at least one thermoformed part;

capturing and holding the at least one thermoformed part with the pick and place tool;

removing the pick and place tool with the at least one thermoformed part engaged therewith from within the trim press;

positioning the pick and place tool with the at least one thermoformed part engaged therewith at a location outside of the trim press; and

releasing the at least one thermoformed part from the pick and place tool.

[c37] The method defined in Claim 36 including the step of:
positioning a conveyance system adjacent the trim press;
maneuvering the pick and place tool with the at least one thermoformed part engaged therewith over the conveyance system;
releasing the at least one thermoformed part from the pick and place tool onto said conveyance system.

[c38] A method for removing at least one molded part from a trim press associated with a thermoforming process wherein the trim press is moveable between an open and closed position and is adapted to separate the at least one molded part from a web of material used in the thermoforming process, said method comprising the steps of:
providing a cutting tool associated with the trim press, said cutting tool completely severing the at least one molded part from the web of material when the trim

press is in its closed position;
providing a support structure positioned adjacent the trim press;
providing a pick and place mechanism mounted on said support structure;
providing a drive system for moving and manipulating the pick and place mechanism within the trim press when the trim press is in its open position;
providing holding means associated with the trim press for holding the at least one severed molded part within the trim press after severing occurs;
providing holding means associated with the pick and place mechanism for capturing and holding the at least one molded part when the trim press is in its open position and when the pick and place mechanism is maneuvered adjacent the at least one severed molded part; and
providing controller means for controlling movement of the pick and place mechanism into and out of the trim press, movement of the pick and place mechanism being synchronized with the opening and closing of the trim press such that the pick and place mechanism will engage and remove the at least one molded part from the trim press when the trim press is in its open position.

[c39] The method defined in Claim 38 including the step of:
providing a drive system coupled to said support struc-

ture for rotationally moving said pick and place mechanism relative to said support structure.

[c40] The method defined in Claim 38 including the step of: providing a conveyance system positioned adjacent the trim press for receiving the at least one severed part from the pick and place mechanism.

[c41] An method for removing a plurality of thermoformed parts from a trim press associated with a thermoforming process wherein the trim press is moveable between an open and closed position and is adapted to separate the thermoformed parts from a sheet of material which is fed through the thermoforming process and through the trim press, said method comprising the steps of: providing a cutting tool associated with the trim press for completely severing the plurality of parts formed within the sheet of material from said sheet of material when the trim press is in its closed position; providing a support structure mounted adjacent the trim press; providing a pick and place mechanism mounted to said support structure for movement into and out of the trim press; providing a plurality of orifices associated with the trim press for pulling a vacuum therethrough, said orifices being positioned and located so as to hold and acquire

the severed thermoformed parts once the parts are severed from the sheet of material;
providing vacuum means associated with the pick and place mechanism for engaging and holding the severed parts for removal from the trim press; and
providing programmable controller means for controlling movement of the pick and place mechanism into and out of the trim press, movement of the pick and place mechanism being synchronized with the opening and closing of the trim press such that the plurality of severed thermoformed parts can be removed therefrom.

[c42] The method defined in Claim 41 including the step of:
providing a conveyance system positioned and located adjacent said support structure for receiving the severed parts from the pick and place mechanism when they are removed from the trim press.

[c43] A method for removing a plurality of thermoformed articles from a trim press wherein said articles are formed from a sheet of thermoplastic material in a thermoforming system, the trim press being moveable between an open and closed position and being adapted for removing the thermoformed articles from the sheet of material, the method comprising the steps of:
providing a plurality of knife blades associated with the trim press for completely severing the plurality of ther-

moformed articles from the sheet of material when the trim press is in its closed position;

providing a support structure positioned adjacent the trim press, said support structure including at least a pair of horizontal support members and at least a pair of vertical support members, a carriage member coupled to said horizontal and vertical support members, and a quick disconnect mechanism associated with said carriage member;

providing a pick and place mechanism mounted to said quick disconnect mechanism for movement into and out of the trim press;

providing a drive mechanism associated with some of said support members for moving said pick and place mechanism in at least a horizontal and vertical direction relative to said horizontal and vertical support members;

providing vacuum means associated with the trim press for holding the severed thermoformed articles within the trim press until removed therefrom;

providing vacuum means associated with said pick and place mechanism for capturing and holding the plurality of severed thermoformed articles when said pick and place mechanism is maneuvered into the trim press; and

providing controller means for controlling movement of the pick and place mechanism into and out of the trim press, movement of the pick and place mechanism being

synchronized with the opening and closing of the trim press.

[c44] The method defined in Claim 43 including the step of: providing a conveyance system adjacent said support structure for receiving the thermoformed articles from the pick and place mechanism when they are removed from the trim press.